

REMARKS

This application has been reviewed in light of the Office Action dated February 20, 2004. In view of the foregoing amendments and the following remarks, favorable reconsideration and withdrawal of the rejections set forth in the Office Action are respectfully requested.

Claims 41, 42 and 45 are pending. Claims 43 and 44 have been canceled herein without prejudice or disclaimer of subject matter. Claims 41, 42 and 45 have been amended. Support for the claim changes can be found in the original disclosure, and therefore no new matter has been added. Claim 41 is the sole independent claim.

Claims 41, 42 and 45 were rejected for obviousness-type double patenting over claims 1-52 of U.S. Patent No. 5,821,962 (*Kudo et al.*), in view of U.S. Patent No. 4,409,596 (*Ishii*) and U.S. Patent No. 5,124,716 (*Roy et al.*).

Claims 43 and 44 were rejected for obviousness-type double patenting over claims 1-52 of *Kudo et al.* in view of *Ishii* and *Roy et al.* and further in view of EP 0 326 428 (*Terasawa*).

Since Claims 43 and 44 have been canceled, the rejection of these claims is moot. In response to the rejection of the other claims, Applicants submit the following remarks.

Applicants submit that amended independent Claim 41, together with the remaining claims dependent thereon, are patentably distinct from the proposed combination of the cited prior art at least for the following reasons.

One of the features of the invention as set forth in independent Claim 41 is control means for controlling heat generating elements in such a manner as to generate heat to

displace movable members without ejecting ink, and to generate heat again before the movable members have returned to their original positions.

This feature is illustrated, for example, in Fig. 51, and discussed in the specification, for example, at page 111, line 18 - page 112, line 17 and page 105, line 20 - page 106, line 27. Of course, the detail of the drawings and the specific examples in the specification are not to be taken as limiting the scope of the claims.

Kudo et al. relates to a liquid ejection apparatus and method including a movable member. Applicants submit that, as the Office Action is understood to concede, nothing in claims 1-52 of *Kudo et al.* would teach or suggest the above-noted feature.

Ishii relates to a method and apparatus for driving an ink jet printer head. *Roy et al.* relates to a method and apparatus for printing with ink drops of varying sizes using a drop-on-demand ink jet print head.

Regarding *Ishii* and *Roy et al.*, the Office Action (pages 2 and 3) states:

Ishii teaches an ink jet print head, wherein the meniscus is bulged out by an intermediate pulse, which does not eject ink. After the intermediate pulse, an ejection pulse is applied to discharge an ink drop

Roy teaches that piezoelectric actuators and thermal ink jet heaters are known equivalents in the art . . . [it] would have [been] obvious to have substituted a heater for the piezoelectric actuator of Ishii,

Supplying a heat generating element with energy insufficient to eject ink, but sufficient to generate a bubble that would displace the meniscus would inherently cause movement in the ink. Such movement would inherently induce movement in a movable member, such as the one disclosed in *Kudo et al.*

Applicants submit that, as the Office Action is understood to concede, nothing in *Roy et al.* would teach or suggest the above-noted feature, i.e., control means for controlling heat generating elements in such a manner as to generate heat to displace movable members

without ejecting ink, and to generate heat again before the movable members have returned to their original positions.

According to Applicants' understanding, *Ishii* teaches that pulses 19 and 18 are applied, at different times, to piezoelectric element 7. Pulse 19 differs from pulse 18 in that the "initial rate of change of displacement of the piezoelectric element" is lesser when pulse 19 is applied than when the pulse 18 is applied (col. 6, lines 4-6). As a result, pulse 19 is not sufficient to cause ink to be ejected.

Upon application of pulse 19, "a meniscus . . . curves outwardly from the nozzle 6," and then "the ink moves back into the nozzle. The meniscus is moved back into the nozzle in association with the return operation of the piezoelectric element However, it is unnecessary for the meniscus to reach equilibrium and return to the nozzle tip before the next pulse is applied . . ." (col. 6, lines 12-20).

The pulses 19 are repeated (pulses 18 being selectively applied between pulses 19 when it is desired to eject ink), to create conditions of dynamic stabilization, so as to stabilize ink droplet volume.

In other words, in *Ishii*, the meniscus is vibrated in order to control the amount of ink ejected. The ink is pushed by a non-ejection pulse, then the ink and meniscus are retracted in to the nozzle on the rebound, and then the ink is ejected by an ejection pulse.

It is noted that, in *Ishii*, after the non-ejection pulse, the meniscus retracts to and beyond its original position, and only then is the ejection pulse applied. This is indicated by the above-quoted language: "The meniscus is moved back into the nozzle in association with the return operation of the piezoelectric element However, it is unnecessary for the meniscus

to reach equilibrium and return to the nozzle tip before the next pulse is applied . . .” (col. 6, lines 14-20; emphasis added). Thus the meniscus is retracted inward from the nozzle tip, to and beyond its original position, and then the ejection pulse is applied (before the meniscus returns outward to reach its original position again.)

Applicants submit that *Ishii* does not teach or suggest the above-noted feature of Claim 41, and that *Ishii*’s application of energy to ink and consequent movement induced in the ink would not inherently cause such movement of a movable member as to meet the above-noted feature of Claim 41.

The failure of *Ishii* to inherently meet the above-noted feature of Claim 41 may be explained by considering the hypothetical combination of references proposed by the Examiner, in which *Ishii*’s regime of pulses would be applied to *Roy et al.*’s heaters and *Kudo*’s structure including a movable member. In such a combination, after the non-ejection pulse is applied, the movable member would be displaced upward, then back downward to its original position and then beyond its original position toward the heater, and then the ejection pulse would be applied. That is, the ejection pulse would be applied after the movable member had returned to its original position and gone beyond it. However, Claim 41 recites a control means for controlling heat generating elements in such a manner as to generate heat to displace movable members without ejecting ink, and to generate heat again before the movable members have returned to their original positions. Accordingly, neither *Ishii* nor the proposed combination of references is seen to meet the limitations of Claim 41.

Since none of the cited references, whether taken singly or in combination (even assuming, for the sake of argument, that such combination were permissible), contains all of the elements of independent Claim 41, that claim is believed allowable over the cited art.


A review of the other art of record has failed to reveal anything which, in Applicants' opinion, would remedy the deficiencies of the art discussed above, as references against independent Claim 41. That claim is therefore believed patentable over the art of record.

The other claims in this application are each dependent from independent Claim 41 and are therefore believed patentable for at least the same reasons. Since each dependent claim is also deemed to define an additional aspect of the invention, however, the individual reconsideration of the patentability of each on its own merits is respectfully requested.

In view of the foregoing amendments and remarks, Applicants respectfully request favorable reconsideration and early passage to issue of the present application.

Applicants' undersigned attorney may be reached in our Washington, D.C. office by telephone at (202) 530-1010. All correspondence should continue to be directed to our below-listed address.

Respectfully submitted,



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